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PRIORITY APPLICATION

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**Modularly Constructed Paper Machine Covering**

This invention relates to a method for the modular production of coverings for paper machines, paperboard machines or tissue machines and to a covering for a paper machine, paperboard machine or tissue machine.

Paper machines, paperboard machines or tissue machines have coverings in the forming section, press section and drying section.

The different categories of coverings, namely forming meshes, press felts and dryer fabrics, must meet many different requirements, for example with regard to dewatering behavior, moisture adsorption capacity and the like.

Furthermore, coverings of the same category must meet different requirements depending on the operating conditions. For example, the requirements imposed on the structure of the side of a forming mesh facing the fibrous web in the production process for graphic paper differ fundamentally from those for the production of tissue.

Due to the different categories of coverings described above, each of which has to meet many different requirements, the historical development has seen the manufacturers of coverings produce, for practically every category and operating condition, a covering type which differs almost fundamentally from the covering types of other categories and operating conditions.

For example, covering manufacturers often produce forming meshes with different weave patterns for specific customers.

Proceeding from the coverings known from the prior art it is the object of the current invention to propose a method for the production of coverings as well as coverings which are easier and cheaper to produce than those coverings known from the prior art.

The object of the invention is accomplished in accordance with the invention by a method with the features of patent claim 1 and by a covering for paper machines, paperboard machines or tissue machines with the features of patent claim 12.

Advantageous embodiments and further aspects of the invention are disclosed in the subclaims.

The invention is based on the idea of reducing the production costs of coverings for paper machines, paperboard machines or tissue machines by simplifying the production method for the entire product range of paper machine coverings.

The method according to the invention provides for producing different categories of coverings modularly from a construction kit of prefabricated web-shaped material layers. According to the invention, several web-shaped material layers are selected from the construction kit of prefabricated web-shaped material layers depending on the category and operating condition of the covering to be produced. The web-shaped material layers selected from the construction kit are stacked atop one another and joined to one another at least in sections, two-dimensionally, and in a manner that prevents them from being detached.

In other words, a method is proposed which provides a construction kit of prefabricated material layers. By defining a construction kit of prefabricated web-shaped material layers for the entire product range of paper machine coverings and by selecting prefabricated web-shaped material layers from the construction kit, depending on the category and the operating conditions of the covering, the number of different material layers and, for example, weave structures is greatly reduced.

Whereas in the past a different weave structure was required for each operating condition for example, it is possible in accordance with the invention to produce coverings for the different categories and operating conditions by combining several of the prefabricated web-shaped material layers.

According to a preferred embodiment, provision is made for the order in which the selected web-shaped material layers are stacked to depend on the category and the operating conditions of the covering. The flexibility in using the prefabricated material layers is thus increased, as different properties of the covering can be achieved in addition depending on the order in which the selected web-shaped material layers are stacked.

In this connection it should be noted that the prefabricated web-shaped material layers are constructed such that they fulfill, on their own or in combinations, specific functions such as damping properties, dimensional stability, wear stability, surface properties, liquid adsorption capacity and the like.

According to a particularly preferred embodiment, provision is made for the construction kit of prefabricated material layers to comprise at least one material layer influencing the surface of a fibrous web and at least one wear-stable material layer. In this case the material layer influencing the surface of the fibrous web is understood to be the material layer which terminates the covering in the direction of the fibrous web. Furthermore, the wear-stable material layer is understood to be the material layer which terminates the covering in the direction of the paper machine.

According to another preferred embodiment, provision is made for the construction kit of prefabricated material layers to comprise at least one dimensionally stable material layer. The dimensionally stable material layer can be configured either as a material layer which is constructed separately to the two previously mentioned material layers or as an integral component of the one or other previously mentioned material layers.

Various possibilities for the construction of the above mentioned material layers are conceivable.

A preferred embodiment of the invention provides for the material layer influencing the surface of the material web to be a textile or a non-textile areal structure.

Another preferred embodiment of the invention provides furthermore for the wear-stable material layer to be a textile or a non-textile areal structure.

Another preferred embodiment of the invention provides for the construction kit of prefabricated material layers to comprise at least one material layer influencing the liquid adsorption capacity. The material layer influencing the liquid adsorption capacity can be constructed either separately to the previously mentioned material layers or as an integral component of one of the previously mentioned material layers.

The material layer influencing the liquid adsorption capacity can be constructed either as a material layer with a high liquid adsorption capacity or as a material layer with a low liquid adsorption capacity.

A material layer with a high liquid adsorption capacity should have a liquid adsorption capacity which is greater than 50% of the total capacity of the material layer, in particular preferably greater than 70% of the total capacity of the material layer and most particularly preferably greater than 80% of the total capacity of the material layer.

A material layer with a low liquid adsorption capacity should have a liquid adsorption capacity which is less than 50% of the total capacity of the material layer, in particular preferably less than 30% of the total capacity of the material layer and most particularly preferably less than 20% of the total capacity of the material layer.

According to another preferred embodiment of the invention, provision is made for the construction kit of prefabricated web-shaped material layers to comprise at least one anti-rewetting material layer.

Furthermore, preferred embodiments provide for the dimensionally stable material layer and/or the material layer influencing the liquid adsorption capacity and/or the anti-rewetting material layer to be textile or a non-textile areal structures.

A textile areal structure is understood to be a weave structure or a fleece or a thread plaiting or a warp knitting.

Furthermore, a non-textile areal structure is understood to be a structured and/or penetrated film or a structured and/or penetrated membrane and/or a foamed layer.

It is advantageous, for example, for the material layer with a large liquid adsorption capacity to be a foamed layer.

Furthermore, it is advantageous for the material layer with a small liquid adsorption capacity to be a foamed layer or a penetrated film or a membrane.

Furthermore, it is advantageous for the foamed layer to have a defined pore size. By providing a defined pore size it is possible, for example, to establish the liquid adsorption capacity and hence the dewatering behavior. Furthermore, it is also conceivable for the foamed layer belt to have several defined pore sizes.

According to a preferred embodiment of the invention the foamed layer has a defined pore transverse profile, i.e. different pore sizes in the transverse profile of the material layer. It is thus possible to selectively establish the dewatering behavior and the pressing behavior by way of the web width of the paper machine covering, as the result of which the fibrous web transverse profile can be selectively established.

A film mentioned above can be produced by an extrusion method and/or a rolling method for example.

Various possibilities for joining together the several material layers selected from the construction kit are conceivable.

For example, it is possible for at least two of the material layers to be joined together chemically. Furthermore, it is possible for at least two of the material layers to be joined together mechanically and/or by means of a textile joining method. The different material layers of a covering according to the invention can be joined together by just one or the other means. However, it is also possible for the material layers to be joined together not only mechanically but also by textile and chemical means.

For example, a first material layer of a covering according to the invention can be joined mechanically to a second material layer and the second material layer can be joined chemically to a third material layer. Furthermore, the third material layer can be joined by a textile joining method to a fourth material layer of this covering, with the fourth material layer being joined mechanically and chemically to a fifth material layer.

According to a another preferred embodiment the chemical bond is effected by an interface-active bond. In this connection an interface-active bond is understood to be a bond resulting from vulcanizing or melting or welding (e.g. ultrasonic welding). In other words, the interfaces of the two material layers which are to be joined together are changed / activated in such a way that they bond together without a bonding medium.

Another embodiment of the invention provides for the chemical bond to be effected by introducing a bonding medium. In this case the bonding medium can be an adhesive for example.

Furthermore it is possible for the bonding medium itself to form a material layer between the joined material layers, in which case the bonding medium is a foamed material layer for example, which is arranged between the material layers that are joined together and bonds said material layers together.

Needless to say, the bonding medium constructed as a separate material layer can fulfill specific functions on its own or in combination with one or more material layers. For example, by combining the bonding medium with one or more material layers it is possible to exert an advantageous influence on the properties of the covering according to the invention.

If the material layers are joined together mechanically it is conceivable for them to be pressed together.

If the material layers are joined together by a textile joining method it is possible for them to be sewn or pinned together.

If the covering is one which is not constructed of material webs in the form of endless belts it makes sense for the various web-shaped material layers which are stacked atop one another to be joined together, two-dimensionally, in sections that are mutually offset in machine direction so that the covering forms two end areas which complement each other in form and function and can be joined together. Through the material layers which are mutually offset in machine direction and joined together, two-dimensionally, in sections, the covering forms two end areas which complement each other in form and function and can be joined together, two-dimensionally, so that the covering is constructed in the form of an endless belt. The two-dimensional bond between the two end areas is particularly stable and durable.

If the covering is constructed of several material layers arranged side by side over its width, it also makes sense for the material layers which are stacked atop one another to be mutually offset at least in sections transverse to the machine direction so that above and/or under neighboring material layers of a certain layer of the covering there is always a material layer which overlaps with both material layers arranged side by side.

The invention will be explained below in more detail with reference to the following schematic figures (not drawn to scale). In the drawing:

Figure 1 is a detail in longitudinal section of a forming mesh according to the invention,

Figure 2 is a detail in longitudinal section of a press felt according to the invention,

Figure 3 is a detail in longitudinal section of a dryer fabric according to the invention,

Figure 4 shows the two end areas of the forming mesh of the invention according to Figure 1,

Figure 5 is a detail in cross section of a forming mesh according to the invention,

Figure 6 is a detail in cross section of a press felt according to the invention,

Figure 7 is a detail in cross section of a dryer fabric according to the invention.

Figures 1 to 4 show coverings which are produced from a construction kit of prefabricated web-shaped material layers 2, 3, 4, 11 and 15. All the web-shaped material layers 2, 3, 4, 11 and 15 of the construction kit are formed in this embodiment as non-textile areal structures.

Figure 1 shows in longitudinal section in machine direction sections of a forming mesh 1 according to the invention. The forming mesh 1 has a paper-side web-shaped material layer 2 through which the surface of the fibrous web formed on the forming mesh is essentially influenced, and a machine-side web-shaped material layer 3 through which the wear behavior of the forming mesh 1 is essentially influenced. The machine-side material layer 3 is thus a wear-stable material layer 3. In the embodiment in question the machine-side material layer 3 has dimension-stabilizing properties in addition. The machine-side material layer 3 is thus also a dimension-stable material layer 3, as the result of which the dimension-stable and the wear-stable material layer 3 form an integral unit.

Arranged between the paper-side material layer 2 and the machine-side material layer 3 is a material layer 4 influencing the liquid adsorption capacity.

The material layers 2 to 4 were taken from the construction kit of prefabricated web-shaped materials layers 2, 3, 4, 11 and 15 in order to produce the forming mesh 1 of the invention (see also Figures 2 and 3).

In the embodiment in question the material layer 2 is formed as a non-textile areal structure in the form of a penetrated film with holes 5 and is produced from a material such as PE, PET, PPS or PA. The paper-side material layer 2 is undetachably joined, two-dimensionally at the interface 7, to the material layer 4 influencing the liquid absorption capacity by chemical means through application of a bonding medium 72 in the form of an adhesive 72.

The material layer 4 influencing the liquid absorption capacity is formed as a foamed layer with pores 9. In this case the pores have a defined size.

In the embodiment in question the material layer 3 is formed as a non-textile areal structure in the form of a penetrated film with holes 6 and is produced from a material such as PE, PET, PPS or PA. The machine-side material layer 3 is undetachably joined, two-dimensionally at the interface 8, to the material layer 4 influencing the liquid absorption capacity by chemical means through application of a bonding medium 72 in the form of an adhesive 72.

Figure 2 shows in longitudinal section in the machine direction sections of a press felt 10 according to the invention. The press felt 10 is formed by the paper-side web-shaped material layer 2 known from Figure 1, the machine-side web-shaped material layer 3 known from Figure 1, the material layer 4 influencing the liquid absorption capacity known from Figure 1, by a material layer 11 likewise influencing the liquid absorption capacity and by an anti-rewetting material layer 15.

All the material layers 2, 3, 4, 11 and 15 were taken from the construction kit of prefabricated web-shaped material layers 2, 3, 4, 11 and 15 in order to produce the press felt 10 of the invention. The order in which the individual material layers are stacked atop one another is defined by the operating conditions for which the press felt 10 of the invention is designed.

The material layer 2 is joined, at the interface 13, to the anti-rewetting material layer 15 by chemical means through application of a bonding medium 72 in the form of an adhesive 72.

The material layer 11 influencing the liquid absorption capacity is formed as a foamed layer with pores 12. In this case the pores 12 have a defined size which is greater than the size of the pores 9. The anti-rewetting material layer 15 is joined, at the interface 16, to the material layer 11 influencing the liquid absorption capacity by chemical means through application of a bonding medium 72 in the form of an adhesive 72.

The two material layers 4 and 11 influencing the liquid adsorption capacity are undetachably joined together, two-dimensionally at the interface 14, by chemical means in the form of an adhesive bond 72.

The machine-side material layer 3 is undetachably joined, two-dimensionally at the interface 8, to the material layer 4 influencing the liquid absorption capacity by chemical means through application of a bonding medium 72 in the form of an adhesive 72.

Figure 3 shows in longitudinal section in the machine direction sections of a dryer fabric 20 according to the invention. The dryer fabric 20 is formed from the paper-side web-shaped material 2 known from Figures 1 and 2 and from the machine-side web-shaped material layer 3 known from Figures 1 and 2.

The two material layers 2 and 3 are undetachably joined together, two-dimensionally at the interface 21, by chemical means in the form of an adhesive bond 72.

Figure 4 shows a detail in longitudinal section in the machine direction of the forming mesh 1 of the invention in the area of the two end areas 30 and 31 of the forming mesh 1. In the situation illustrated, the two end areas 30 and 31 are not yet brought fully into contact with each other

As is evident from Figure 4, the web-shaped material layers 2, 3 and 4 are mutually offset in machine direction and joined together, two-dimensionally, in sections. As the result, the two end areas complement each other in form and function and can be joined together two-dimensionally.

Figures 5 to 7 show coverings which are produced from a construction kit of prefabricated web-shaped material layers 41, 42 and 61.

Figure 5 shows in cross section, meaning transverse to the machine direction, sections of a forming mesh 40 according to the invention. The forming mesh 40 has a paper-side web-shaped material layer 41 through which the surface of the fibrous web formed on the forming mesh is essentially influenced, and a machine-side web-shaped material layer 42 through which the wear behavior of the forming mesh 40 is essentially influenced. The machine-side material layer 42 is thus a wear-stable material layer 42. In the embodiment in question the paper-side 41 and machine-side material layer 42 have dimension-stabilizing properties in addition.

The material layers 41 and 42 are formed in this embodiment as textile areal structures in the form of weave structures 41 and 42.

The weave structure 41 is formed by the warp threads 45 and the weft threads 44, whereby each weft thread 44 passes alternately under and over a warp thread 45 in order to form a smooth weave pattern, thus creating a smooth contact area for the paper fibers.

The weave structure 42 is formed by the warp threads 46 and the weft threads 47, whereby each weft thread 47 in a repeat unit passes under two consecutive warp threads 46 and then over one warp thread 46 in order to form a particularly wear-stable weave pattern in which the highly tensioned warp threads are protected by the weft threads 47 against wear.

In the embodiment in question the two weave structures 41 and 42 are joined together, two-dimensionally at the interfaces 48 and 19, by chemical means through a bonding medium. Here the bonding medium itself forms a foamed material layer 43, which is arranged between the two joined weave structures 41 and 42 . The foamed material layer 43 has pores 50 with a defined size. This means that the foamed material layer 43 has the function of joining together the two weave structures 41 and 42 in addition to the function of influencing the liquid adsorption capacity.

Figure 6 shows in cross section, meaning transverse to the machine direction, sections of a press felt 60 according to the invention. The press felt 60 has the machine-side weave structure 42 known from Figure 5 and a fleece 61 with fibers 62.

The fleece 61 and the weave structure 42 are joined together at the two interfaces 63 and 49 by the bonding medium 43 forming a material layer 43. In the case of the press felt 60, the bonding medium again has the function of joining together the weave structure 42 and the fleece 61 as well as the function of influencing the liquid adsorption capacity of the press felt 60.

Figure 7 shows in cross section, meaning transverse to the machine direction, sections of a dryer fabric 70 according to the invention. The dryer fabric 70 has the paper-side weave structure 41 known from Figure 5 and the machine-side weave structure 42 known from Figure 5.

The two weave structures 41 and 42 are joined together, two-dimensionally, by chemical means through a bonding medium 71 in the form of an adhesive 71.

List of reference numerals:

| | |
|---|---|
| 1 | Forming mesh |
| 2 | Paper-side material layer |
| 3 | Machine-side material layer |
| 4 | Material layer defining the liquid adsorption capacity |
| 5 | Holes (paper-side material layer) |
| 6 | Holes (machine-side material layer) |
| 7 | Interface |
| 8 | Interface |
| 9 | Pores (material layer defining the liquid adsorption capacity) |
| 10 | Press felt |
| 11 | Material layer defining the liquid adsorption capacity |
| 12 | Pores (material layer defining the liquid adsorption capacity) |
| 13 | Interface |
| 14 | Interface |
| 15 | Anti-rewetting material layer |
| 16 | Interface |
| 20 | Dryer fabric |
| 21 | Interface |
| 30 | End area |
| 31 | End area |
| 40 | Forming mesh |
| 41 | Weave structure (paper-side material layer) |
| 42 | Weave structure (machine-side material layer) |
| 43 | Bonding medium (material layer defining the liquid adsorption capacity) |
| 44 | Weft thread (weave structure) |
| 45 | Warp thread (weave structure) |
| 46 | Warp thread (weave structure) |
| 47 | Weft thread (weave structure) |
| 48 | Interface |
| 49 | Interface |
| 50 | Pores (bonding medium) |
| 60 | Press felt |
| 61 | Fleece |
| 62 | Fibers (fleece) |

63 Interface

70 Dryer fabric

71 Bonding medium

72 Adhesive